User Manual

FieldMate™

Laser Power Meter

COHERENT

User Manual
FieldMate
Laser Power Meter

COHERENT
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Portland, OR 97224

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In the US:

Should you experience difficulties with your product, or need technical information, please visit our website: www.Coherent.com. You can obtain additional support by either telephoning our Technical Support Hotline at 1.800.343.4912, or e-mailing our Support Team at support.instruments@Coherent.com. Telephone coverage is available Monday through Friday (except U.S. holidays).

If you call outside our office hours, your call will be taken by our answering system and will be returned when the office reopens.

If there are technical difficulties with your product that cannot be resolved by support mechanisms outlined above, please e-mail or telephone Coherent Technical Support with a

description of the problem and the corrective steps attempted. When communicating with our Technical Support Department, via the web or telephone, the model and serial number of the product will be required by the Support Engineer responding to your request.

Outside the U.S.:

If you are located outside the U.S., visit our website for technical assistance, or telephone our local Service Representative. Representative phone numbers and addresses can be found on the Coherent website, www.Coherent.com.

Coherent provides web and telephone technical assistance as a service to its customers and assumes no liability thereby for any injury or damage that may occur contemporaneous with such services. These support services do not, under any circumstances, affect the terms of any warranty agreement between Coherent and the buyer. Operating a Coherent product with any of its interlocks defeated is always at the operator's risk.

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Preface

This manual contains user information for the FieldMate™ laser power meter.

U.S. Export Control Laws Compliance

It is the policy of Coherent to comply strictly with U.S. export control laws.

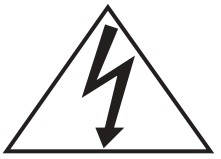
Export and re-export of lasers manufactured by Coherent are subject to U.S. Export Administration Regulations, which are administered by the Commerce Department. In addition, shipments of certain components are regulated by the State Department under the International Traffic in Arms Regulations.

The applicable restrictions vary depending on the specific product involved and its destination. In some cases, U.S. law requires that U.S. Government approval be obtained prior to resale, export or re-export of certain articles. When there is uncertainty about the obligations imposed by U.S. law, clarification should be obtained from Coherent or an appropriate U.S. Government agency.

Publication Updates

To view information that may have been added or changed since this publication went to print, connect to www.Coherent.com.

Symbols Used in This Document

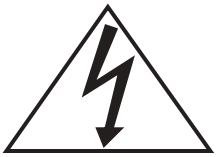


This symbol is intended to alert the operator to the presence of dangerous voltages associated with the product that may be of sufficient magnitude to constitute a risk of electrical shock.

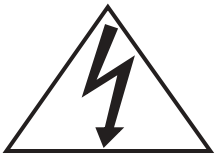
This symbol is intended to alert the operator to the presence of important operating and maintenance instructions.

SAFETY

Carefully review the following safety information to avoid personal injury and to prevent damage to this digitizer or any sensor connected to it. There are no user-serviceable parts in the FieldMate laser power meter. For service information, refer to "Obtaining Service" on page 31.



Use only the power cord specified for the meter. The grounding conductor of the cord must be connected to earth ground.



Do not operate the meter if its panels are removed or any of the interior circuitry is exposed.

Do not operate the meter in wet or damp conditions, or in an explosive atmosphere.

Operate the meter only within the specified voltage range.

Do not apply a voltage outside the specified range of the input connections.

Do not operate the meter if there are suspected failures. Refer damaged units to qualified Coherent service personnel.

Declaration of Conformity

Dr17808 Revision AA

Declaration of Conformity

We

Coherent, Inc.
7470 SW Bridgeport Road
Portland, Oregon, USA 97224

declare that the

FieldMate

meets the intent of Directive 89/336/EEC for Electromagnetic Compatibility. Compliance was demonstrated per testing to EN61326 Electromagnetic Compatibility Product Family Standard for Measurement, Control and Laboratory Equipment to include the following test specifications as of August 2003:

EN55011 Class A Radiated Emissions
EN55011 Class A Conducted Emissions
EN61000-3-3 Powerline Fluctuation Emissions
EN61000-3-2 Powerline Harmonic Emissions

EN61000-4-2 Electrostatic Discharge – Performance Criteria B
Unit may respond to an ESD event but will return to normal without user intervention.

EN61000-4-3 Radiated Immunity – Performance Criteria A
EN61000-4-4 Electrical Fast Transient Immunity - Performance Criteria A
EN61000-4-5 Electrical Slow Transient Immunity- Performance Criteria A
EN61000-4-6 Conducted RF Immunity - Performance Criteria A
EN61000-4-11 Power Line Dropout - Performance Criteria A

Senior Engineering Manager, Instruments — Date: 7/8/04

General Manager, LMC — Date: 7/8/04

Coherent Inc. Page 1 of 1

DESCRIPTION

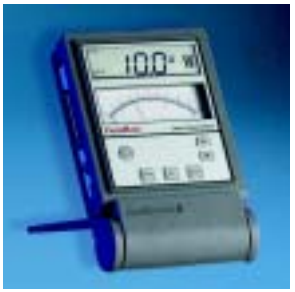
Thank you for purchasing the Coherent FieldMate™ laser power meter—a versatile, easy-to-use meter designed for field service, laser system production, and QA testing.

Specific features of FieldMate include:

- Intuitive softkey user interface.
- Works with thermopile and optical sensors.
- Fast analog tuning.

Meter Stand

Figure 1 shows the attached meter stand in the open (operational) position.



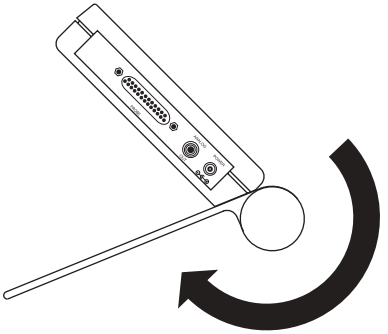


Figure 1. Meter Stand

Front Panel

The front panel is organized as shown in Figure 2. The sensor, analog out, and power connectors—all located on the side panel—are shown in Figure 6 on page 10.

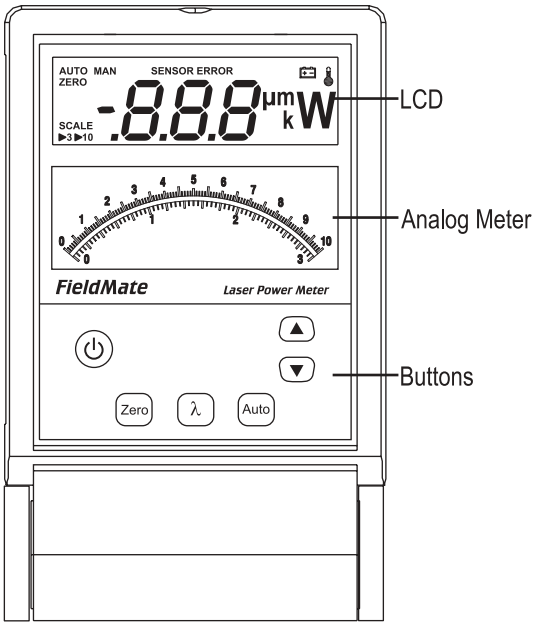


Figure 2. Front Panel

LCD

The LCD—along with the analog meter—provides measurement information. Figure 3 shows all available annunciators and segments that may appear on the LCD.

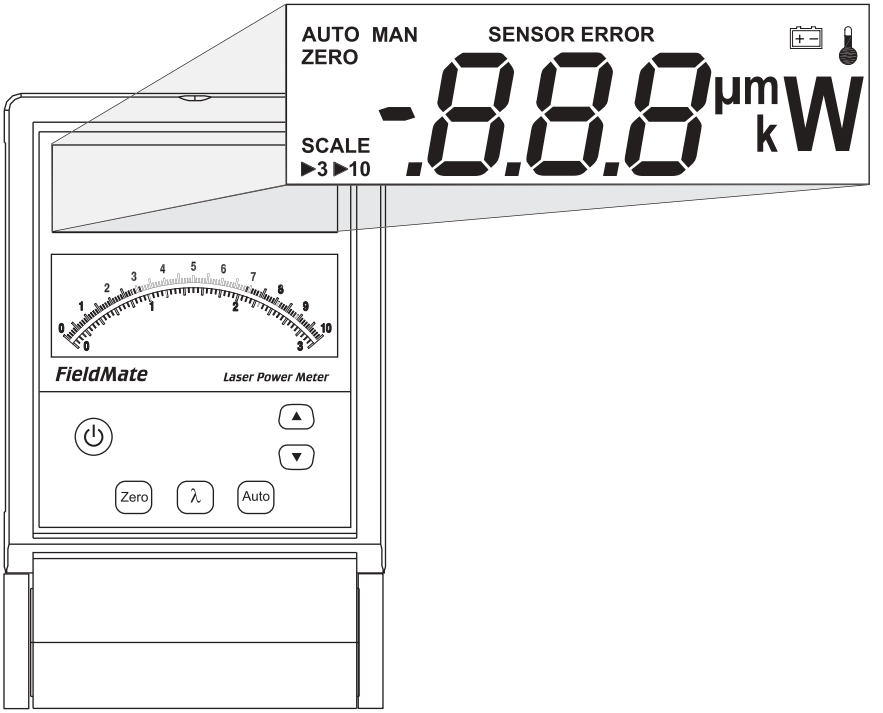


Figure 3. LCD

"Annunciators" on page 18 presents detailed information about each of the annunciators. For information about the analog meter, refer to "Analog Meter" on page 8.

Analog Meter

The analog meter (Figure 4) is a mechanical meter with two hash-marked scales (0 to 3, and 0 to 10). The currently-selected analog scale (either 3 or 10) is indicated on the lower left side of the LCD. For information on how to select a measurement scale for the analog meter, refer to "Up and Down Arrows" on page 17.

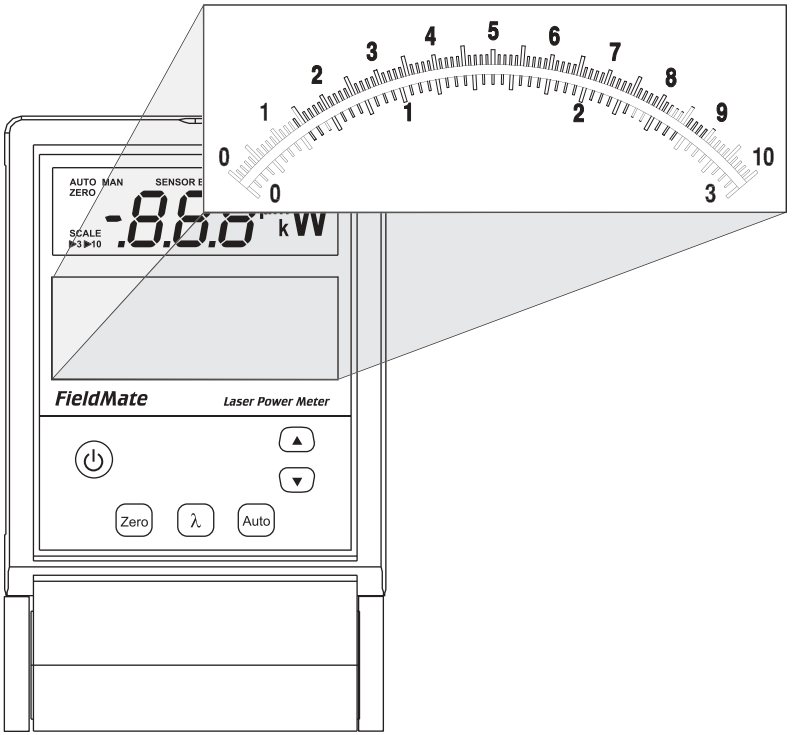


Figure 4. Analog Meter

For information about the digital display, refer to "LCD" on page 7.

Buttons

Figure 5 shows the button locations on the front panel.

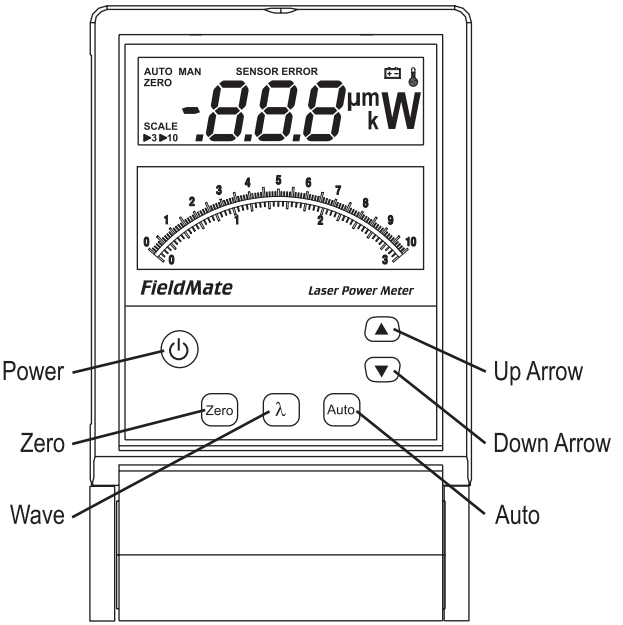


Figure 5. Button Locations

- Power (⏻) - toggles power on and off.
- Zero - toggles Zero on/off (when an optical sensor is attached) or zeros the sensor (when a thermopile sensor is attached).
- Wave (λ) - enters or exits Wavelength Edit mode.
- Auto - toggles Auto Ranging and Manual Ranging mode.

- Up (▲) and Down (▼) arrows - adjusts wavelength, selects range, or toggles numeric display.

Side Panel

The side panel, as shown in Figure 6, contains the Sensor connector, the Analog Out connector, and the Power connector.

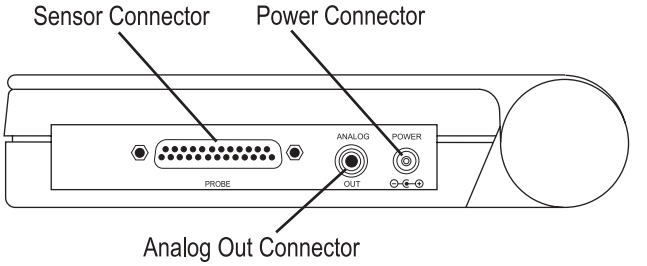


Figure 6. Side Panel

Sensor Connector

Use this connection to attach a DB-25 SmartProbe connector or adapter.

Analog Out Connector

This RCA connector outputs a voltage proportional to the current laser measurement. The voltage is scaled from 0.0V to 2.0V, with 2.0V representing full scale. The voltage is never less than 0.0V and never greater than 2.0V.

Power Connector

Connect the power supply (included with the unit) to this barrel connector. Depending on local power requirements, FieldMate ships with a custom AC adapter. If the adapter is lost, contact Coherent for a replacement.

Battery Replacement

FieldMate can operate on either one or two 9V alkaline or NiMH batteries (refer to the following table).

BATTERY TYPE	NUMBER OF BATTERIES	HOURS OF OPERATION
Alkaline	1	46
	2	92
NiMH[a]	1	97
	2	194

a. NiMH batteries may be used, but the instrument will not recharge them.

Figure 7 illustrates how to replace the batteries.

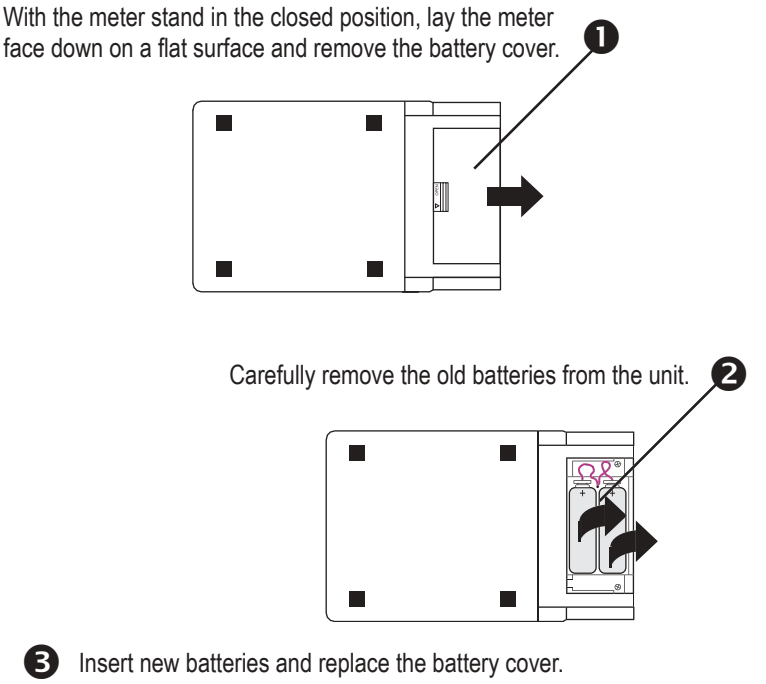

With the meter stand in the closed position, lay the meter face down on a flat surface and remove the battery cover.
1
Carefully remove the old batteries from the unit.
2
3
Insert new batteries and replace the battery cover.

Figure 7. Battery Replacement

Compatible Sensors and Ranges

FieldMate is compatible with all PowerMax thermopiles and OP-2 sensors. Table 1 lists common sensors with their associated ranges (shaded area = compatible).

Table 1. Available Ranges

DIGITAL RANGE	METER SCALE	SENSOR[a]													
		OP-2 UV	OP-2 VIS	OP-2 IR	PS10	PM2	PM3	PM10	PM30	PM150	PM300	PM1K	PM3K	PM5K	PM10K
29.9 kW	3														■
9.99 kW	10												■	■	■
2.99 kW	3											■	■	■	■
999 W	10										■	■	■	■	■
299 W	3									■	■	■	■	■	■
99.9 W	10								■	■	■	■	■	■	
29.9 W	3							■	■	■	■	■			
9.99 W	10							■	■	■	■				
2.99 W	3					■	■	■	■	■					
999 mW	10				■	■	■	■	■						
299 mW	3		■		■	■	■	■							
99.9 mW	10	■	■		■	■	■								
29.9 mW	3	■	■	■	■	■	■								
9.99 mW	10	■	■	■	■										
2.99 mW	3	■	■	■											
999 µW	10	■	■	■											
299 µW	3	■	■	■											
99.9 µW	10	■	■	■											
29.9 µW	3	■	■	■											
9.99 µW	10	■	■	■											
2.99 µW	3	■		■											
999 nW	10			■											

a. LM-thermopile sensors with SmartSensor Adapter are compatible. Several of the listed models are actually a "series" of models (for example, -100 and -200 versions of kW sensors).

OPERATION

This section discusses the following topics:

- Controls (this page)
- Fault codes (page 20)
- Wavelength edit (page 21)

Controls

The front panel display (shown in Figure 2 on page 6) is used to acquire measurement information, obtain feedback during wavelength editing, view various operational modes, and detect error conditions. These capabilities are discussed next.

Button Functions

This section describes the functions of each button.

Power

Pressing this button toggles meter power on/off.

Zero

Pressing the Zero button implements the Zero function. For detailed information about Zero, refer to "ZERO" on page 18.

Wave

(λ) Pressing the Wave button toggles between two modes: Edit Wavelength and Measure. When in Edit Wavelength mode, pressing the Up and Down arrow buttons allows selection of the operational wavelength.

- Available wavelengths are set according to the wavelength correction table in the sensor EEPROM. If there is no wavelength correction table in the sensor EEPROM, the wavelength of operation automatically becomes the calibration wavelength and may not be adjusted.
- The decimal point of the wavelength is fixed.
- The longer an Up or Down arrow is pressed, the faster the measurement changes.

Pressing the Wave button while in the Edit Wavelength mode selects the adjusted wavelength and changes the mode from Edit to Measure.

Whenever instrument power is turned off, FieldMate stores the last wavelength used. The next time the instrument is powered up, that same wavelength will be in effect. However, if another sensor is attached to FieldMate while power is off, and the new sensor is out of wavelength range, FieldMate uses the default calibration wavelength the next time power is restored.

(*Optical sensors only*) Changing the wavelength while in Zero mode, automatically turns off Zero mode.

Auto

Pressing the Auto button toggles between Auto Ranging and Manual Ranging mode. Auto Ranging mode instructs the FieldMate meter to select the best measurement range for the incoming signal. Manual Ranging mode requires the user to select the range.

Up and Down Arrows

The Up and Down arrow buttons serve a dual purpose, depending on which mode (Edit Wavelength or Measure) is currently in use.

- *Edit Wavelength mode*: When in this mode, the Up and Down arrow buttons allow adjustment of the wavelength of operation.
- *Measure mode*: In this mode, the buttons allow selection of the measurement range (either 3 or 10), automatically cancel Auto Ranging (if Auto is active) and, once Auto Ranging has been cancelled, adjust the measurement range.

Display Functions

Measurement Display

The display update rate for the display is three times per second.

Measurement range selection is dependent on the sensor type and characteristics, as well as the wavelength of operation. If a display value is greater than the maximum allowable level for the selected range, over-ranging takes place. An “OL” (overload) appearing on the display

signifies an over-range condition. If over-ranging occurs while in Manual Ranging mode, press the Up arrow until measurement data displays on the LCD.

With Auto Ranging, unless it is at the top range, the instrument automatically ranges up, rather than go into an over-range condition. If the measurement is above the maximum range allowed by the sensor, an over-range condition will occur, even while in Auto Ranging mode.

Annunciators

The update rate for all annunciators is three times per second. Figure 3 on page 7 shows all available annunciators that may appear on the LCD.

AUTO and MAN

The AUTO and MAN annunciators indicate the instrument is either in Auto Ranging or Manual Ranging mode.

ZERO

The ZERO annunciator indicates that the instrument is in Zero mode. This annunciator does not appear when either of the following conditions exist:

- An invalid sensor is attached to the instrument.
- The instrument is in a Non-Zero mode.

Thermopile sensors have a relative zero and, therefore, ZERO is not used with these types of sensors. When a *thermopile* sensor is attached, the current measurement is referenced as the baseline zero power measurement.

Optical sensors, on the other hand, use semiconductor diodes that have an absolute zero reference. When an *optical* sensor is attached to the instrument, pressing the Zero button causes the meter to toggle between the Zero and the Non-Zero modes.

Scale

The Scale annunciator indicates which scale is to be used for the analog meter (0 to 3, or 0 to 10).

SENSOR ERROR

If an invalid or unrecognized sensor is attached to the instrument, the SENSOR ERROR annunciator and a series of three dashes will display on the LCD. If this occurs, contact Customer Service for support (refer to Table 3 on page 32 for contact information).

Battery Low

A flashing Battery Low annunciator indicates the battery voltage is low. From the time the annunciator first starts flashing, there are approximately 12 hours (with alkaline batteries) or seven hours (with NiMH batteries) of measurement time left. There is no change in measurement accuracy—for either type battery—during the time the Battery Low annunciator is flashing.

Over-Temperature

(*Thermopile sensors only*) The Over-Temperature annunciator flashes when FieldMate detects a sensor over-temperature condition.

If an Over-Temperature annunciator appears, IMMEDIATELY turn off the laser to avoid damaging the sensor by overheating.

If the sensor does not seem to function correctly, contact Customer Service for support (refer to Table 3 on page 32 for contact information).

Power-Up Display

Pressing the Power button (refer to Figure 5 on page 9) powers up the instrument. The firmware version is displayed until system initialization is complete.

Fault Codes

When FieldMate detects a fault, the letter “E” appears on the LCD, followed by the appropriate numeric fault code. For example, if the attached sensor has a bad checksum, the display will read “E 4". Pressing any button—except the Power button—dismisses the displayed fault code. Table 2 describes the fault codes

and corrective action. For a description of the different classes of faults, refer to "Instrument Fault Response" on page 24.

Table 2. Fault Codes

FAULT CODE	FAULT DESCRIPTION	ACTION REQUIRED
1	Unrecognized sensor (unknown head code)	Return sensor for repair
2	Sensor communication failure	Return sensor for repair
3	Sensor NVRAM corrupt (invalid data contained in the sensor)	Return sensor for repair
4	Sensor checksum error	Return sensor for repair
5	Sensor/firmware version mismatch (sensor format version exceeds capability of the instrument's firmware)	Return instrument for firmware upgrade
20	Hardware fault (detectable hardware error)	Return instrument to Coherent for repair
40	Bad zero	Reduce laser power or change instrument range
42	Wrong sensor type	Attach valid sensor to the instrument

Wavelength Edit

The wavelength appears on the LCD whenever the instrument is in Edit Wavelength mode. The Up and Down arrow buttons (refer to Figure 5 on page 9) allow the user to increase or decrease the wavelength.

Pressing the Wave (λ) button when in Measure mode toggles to the Edit Wavelength mode and initiates an edit cycle. Pressing the Wave button a second time returns the instrument to Measure mode and ends the edit cycle. Ending the edit cycle automatically commits the current wavelength of operation to use. Pressing the Up and Down arrow buttons during the edit cycle adjusts the wavelength. During an edit cycle, all other button functions—except the Power button—are disabled.

Wavelength Edit Limits

The wavelength limits are determined by the wavelength calibration values stored in the sensor EEPROM. If the currently selected wavelength does not fall within the stored calibration values, the wavelength is automatically set to the calibration wavelength.

Wavelength selection is persistent, meaning calibration values are stores between power cycles.

SPECIAL TOPICS

This section discusses the following topics:

- Analog output (this page)
- Negative power display (this page)
- Instrument fault response (page 24)
- Numeric display stationary pattern (page 25)

Analog Output

The Analog Output connector outputs a voltage proportional to the current laser measurement. Full scale is indicated by 2.0V at the analog output. Zero power is represented by 0.0V at the analog output. Over-ranged measurements are indicated by a 2.0V output. Negative power is indicated by 0.0V. Speedup is always applied to the analog output when a thermopile sensor is attached.

Negative Power Display

Negative power—an indication that the sensor needs to be zeroed—is displayed on the LCD.

Instrument Fault Response

This section describes the internal response of the instrument when a fault is detected.

There are three classes of faults:

1. Sensor
2. Internal
3. Operational

Sensor faults are caused by various problems with sensor identification or data stored in the sensor EEPROM. A sensor fault effectively results in an invalid sensor state. FieldMate does not permit measurement when a faulty sensor is attached.

Internal faults result from some detectable failure of hardware or software. If the fault is firmware related, power cycling—that is, either using the Power button or removing and reinstalling the batteries—may remedy the problem. If the meter is not functioning, and you have replaced the batteries and cycled the power, then the instrument may have a hardware-related fault. Contact Customer Service for support (refer to Table 3 on page 32 for contact information).

Operational faults occur due to operator error. When an operational fault is dismissed, operation continues as if the fault had never happened.

Refer to “Fault Codes” on page 20 for a list of fault conditions and what action to take to correct them.

Numeric Display Stationary Pattern

Some users prefer to turn off the digital numerals while tuning lasers in a production setting. Fieldmate has an operating mode that temporarily replaces the numeric display with a stationary pattern (shown in Figure 8). Pressing the Up and Down arrow buttons simultaneously for longer than one second activates this stationary pattern. To switch back to viewing the numbers, both arrow buttons must again be simultaneously pressed for longer than one second. The numeric display toggle function is not available when the Wavelength Edit cycle is in progress. While the stationary pattern is visible, the range change function associated with the Up and Down arrow buttons is disabled and the annunciators behave as explained under "Annunciators" on page 18.

This display mode is persistent, meaning it will return to this mode after cycling power.

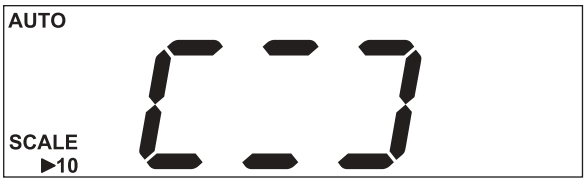


Figure 8. Numeric Display Stationary Pattern

CALIBRATION AND WARRANTY

This section includes information on the following topics:

- Calibration (this page)
- Coherent calibration facilities and capabilities (page 28)
- Limited warranty (page 29)
- Extended lifetime warranty (page 29)
- Warranty limitations (page 30)
- Obtaining service (page 31)
- Product shipping instructions (page 33)

Calibration

Coherent laser power and energy meters are precision instruments, capable of delivering very accurate measurements, as well as providing many years of useful service. To maintain this high level of performance, it is important to have your measurement system serviced and recalibrated once a year.

Coherent Calibration Facilities and Capabilities

As the largest laser manufacturer in the world, Coherent has been able to build state-of-the-art calibration facilities containing the widest possible range of laser types and technologies. This enables us to perform instrument and sensor calibration under virtually any combination of wavelength, power, and operating characteristics. Sensors are calibrated against NIST-traceable working standard sensors which are, in turn, calibrated against NIST-calibrated golden standard sensors. These working and golden standards are maintained with the utmost care, recalibrated annually, and verified even more regularly. We maintain multiple NIST-calibrated standards at many laser wavelengths to support the growing calibration needs of our customers. Optical calibration is a core competency at Coherent and we strive to continually improve our methods, precision, and repeatability. Additionally, most of the calibrations are performed with highly automated systems, thus reducing the possibility of human error to nearly zero. Strict quality inspections during many stages of calibration and testing assure a precise and accurate instrument that is NIST traceable and CE marked. The benefit to our customers is that instruments calibrated by Coherent will consistently perform as expected under their actual use conditions. We are registered to ISO 9001:2000, our products are NIST traceable, and our calibration labs are fully ANSI Z540 compliant.

In addition to the technological advantage, we also strive to deliver the best service in the industry, with a knowledgeable and responsive staff, and rapid turnaround.

Limited Warranty

Coherent, Inc. (the "Company") warrants its laser power and energy meters and sensors products ("Products") to the original purchaser (the "Customer") that the product is free from defects in materials and workmanship and complies with all specifications, active at the time of purchase, for a period of twelve (12) months.

Coherent, Inc. will, at its option, repair or replace any product or component found to be defective during the warranty period. This warranty applies only to the original purchaser and is not transferable.

Extended Lifetime Warranty

Coherent, Inc. (the "Company") offers original purchasers (the "Customer") purchasing laser power and energy meters and sensors products ("Products") an extended, lifetime warranty program, which includes all parts and labor. In order to qualify for this warranty, a Customer must return the Product to the Company for recalibration and recertification (traceable to NIST and MIL-STD-45662A) within one year from the date of purchase, and annually thereafter. The Company will recertify the Product, provide software upgrades, and perform any needed repairs, for a fixed service fee (as established by the Company from time to time and in effect at the time of service).

If the Product fails and is returned to the Company within one year following the date of recalibration service, the Company will, at its option, repair or replace the Product or any component found to be defective. This warranty applies only to the original purchaser and is not transferable.

If the Product is not returned for recalibration or service prior to the one-year anniversary, the lifetime warranty program expires. The lifetime warranty program may be reinstated, at Coherent's option, after completion of a fee-based product evaluation and repair, and subsequent recalibration and recertification service.

Warranty Limitations

The foregoing warranties shall not apply, and Coherent reserves the right to refuse warranty service, should malfunction or failure result from:

- Damage caused by improper installation, handling, or use.
- Laser damage (including sensor elements damaged beyond repair).
- Failure to follow recommended maintenance procedures.
- Unauthorized product modification or repair.
- Operation outside the environmental specifications of the product.

Coherent assumes no liability for Customer-supplied material returned with Products for warranty service or recalibration.

THIS WARRANTY IS EXCLUSIVE IN LIEU OF ALL OTHER WARRANTIES WHETHER WRITTEN, ORAL, OR IMPLIED. COHERENT SPECIFICALLY DISCLAIMS THE IMPLIED WARRANTIES OF MERCHANTABILITY AND FITNESS FOR A PARTICULAR PURPOSE. IN NO EVENT SHALL

THE COMPANY BE LIABLE FOR ANY INDIRECT, INCIDENTAL, OR CONSEQUENTIAL DAMAGES IN CONNECTION WITH ITS PRODUCTS.

Obtaining Service

In order to obtain service under this warranty, Customer must notify the Company of the defect before the expiration of the warranty period and make suitable arrangements for the performance of service. The Company shall, in its sole discretion, determine whether to perform warranty service at the Customer's facility, at the Company's facility or at an authorized repair station.

If Customer is directed by the Company to ship the product to the Company or a repair station, Customer shall package the product (to protect from damage during shipping) and ship it to the address specified by the Company, shipping prepaid. The customer shall pay the cost of shipping the Product back to the Customer in conjunction with annual recalibration and repair; the Company shall pay the cost of shipping the Product back to the Customer in conjunction with product failures within the first twelve months of time of sale or between annual recalibrations.

A Returned Material Authorization number (RMA) assigned by the Company must be included on the outside of all shipping packages and containers. Items returned without an RMA number are subject to return to the sender.

For the latest Customer Service information, refer to our website: www.Coherent.com.

Detailed instructions on how to prepare a product for shipping are shown under "Product Shipping Instructions" on page 33.

Table 3. Coherent Service Centers

LOCATION	PHONE	FAX	E-MAIL
USA	1.800.343.4912	971.327.2777	info_service@Coherent.com
Europe	+49-6071-968-0	+49-6071-968-499	info_service@Coherent.com
International	971.327.2700	971.327.2777	info_service@Coherent.com

Product Shipping Instructions

To prepare the product for shipping to Coherent:

1. Contact Coherent Customer Service (refer to Table 3 on page 32) for a Return Material Authorization number.
2. Attach a tag to the product that includes the name and address of the owner, the person to contact, the serial number, and the RMA number you received from Coherent Customer Service.
3. Wrap the product with polyethylene sheeting or equivalent material.
4. If the original packing material and carton are not available, obtain a corrugated cardboard shipping carton with inside dimensions that are at least 6 in (15 cm) taller, wider, and deeper than the product. The shipping carton must be constructed of cardboard with a minimum of 375 lb (170 kg) test strength. Cushion the instrument in the shipping carton with packing material or urethane foam on all sides between the carton and the product. Allow 3 in (7.5 cm) on all sides, top, and bottom.
5. Seat the shipping carton with shipping tape or an industrial stapler.
6. Ship the product to:

   Coherent, Inc.
   7470 SW Bridgeport Rd.
   Portland, OR 97224
   Attn: RMA # (*add the RMA number you received from Coherent Customer Service*)

APPENDIX A: SPECIFICATIONS

Table 4 lists specifications for the FieldMate.

Table 4. Specifications

PARAMETER	DESCRIPTION
GENERAL	
External Power Supply (included)	90 to 260 VAC, 50/60 Hz
Instrument Power Input	9V Alkaline or NiMH (x 2) 12 VDC (center positive plug)
Sensor Input Connector	DB-25
Update Rate Primary Digits Analog Meter Analog Output Icons	 >= 3 times/sec. >= 20 times/sec. >= 20 times/sec. >= 3 times/sec.
PERFORMANCE	
Input	1.8V max. (thermopile) 25 mA max. (optical)
Measurement Range (full scale) Display Power	 29.9 mW to 29.9 kW (thermopile) 2.99 nW to 99.9 mW (optical)

Table 4. Specifications (Continued)

Measurement Resolution Power	± 0.1% of full scale (thermopile and optical). All ranges in 10's scale. ± 0.3% of full scale (thermopile and optical). All ranges in 3's scale.
Accuracy	
Digital Display	± 1.0% of reading ± 2 LSD (Least Significant Digit)[a]
System	Display unit + sensor accuracy
Analog Meter	± 3.0%
Analog Out	± 1.0%
Analog Meter	
Meter Response	Tau = 80 ms (2 Hz)
Meter Scale	0 to 3, 60 divisions, and 0 to 10, 100 divisions.
Analog Output	
Full Scale Voltage	2.0 VDC full scale on the current range
Noise	< 1 mV P-P
Resolution	< 0.1%
Update Rate	20 times a second
Standard Uncertainty	
Digital Display	± 0.8%
ENVIRONMENTAL	
Temperature	
Operating	5 to 40°C (41 to 104°F)
Storage	-20 to 70°C (-4 to 158°F)
Relative Humidity (non-condensing)	
Operating	0 to 90%
Storage	0 to 95%

Table 4. Specifications (Continued)

Altitude	
Operating	-100 to 2,000 m
Storage	-100 to 4,000 m
Shock and Vibration	Complies with MIL-PRF-28800F Class 3 (or Class 2 drip proof)
EMC	Meets the intent of Directive 89/336/EEC, using applicable parts of EN61326
EN55011	Class A Radiated Emissions
EN55011	Class A Conducted Emissions
EN61000-4-2	Electrostatic Discharge - Performance Criteria B (Unit may respond to an ESD event but will return to normal operation without user intervention.)
EN61000-4-3	Radiated Immunity - Performance Criteria A
EN61000-4-4	Electrical Fast Transient Immunity - Performance Criteria A
EN61000-4-5	Electrical Slow Transient Immunity (Performance Criteria A
EN61000-4-6	Conducted RF Immunity - Performance Criteria A
EN61000-4-11	Power Line Dropout - Performance Criteria A
EN61000-3-3	Powerline Fluctuation & Flicker Emission
MISCELLANEOUS	
Regulations Met	CE

Table 4. Specifications (Continued)

SAFETY	
	Complies with EU Directive 92/59/EEC Designed and tested to EN61010-1-2001 Pollution Degree2 Installation Category II Equipment Class I (single insulation/Earthed metal case Protection against water ingress IP4X (general indoor conditions) Input circuitry and connections (creepage and clearances) Designed to interface at Installation or Measurement Category I
EFFICACY	
	Meets or exceeds IEC 61040-1990 Class 1[b]
PHYSICAL CHARACTERISTICS	
Size (h x w x d)	19.3 x 11.7 x 4.6 cm (7.6 x 4.6 x 1.8 in.)
Weight (including battery)	0.8 kg (1.75 lb.)
Display (viewing area) (h x w)	26.2 x 88.9 mm (1.0 x 3.5 in.) fixed-segment LCD

a. When using a PM2 model thermopile sensor in the 9.99 mW range, the accuracy is ± 1.0% and ± 5 LSD with no averaging. While in the 2.99 mW range, the accuracy with this sensor is ± 1.0% and ± 10 LSD.
b. Meter meets or exceeds IEC 61040-1990 Class 1. Meter and sensor system meet or exceed IEC 61040-1990 Class 5.

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